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Mathematics Instructional Practices and Assessment Accommodations by Secondary Special and General Educators

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ABSTRACT: *A nationwide random sample of 179 secondary general education math and special education teachers completed a survey asking them about their use of specific instructional practices to help teach math to students with learning disabilities (LD) and emotional/behavioral disorders (EB/D) and their use of specific assessment accommodations with these students. Although general education teachers were generally more knowledgeable about higher level mathematics content (e.g., algebra) than special education teachers, they were less likely to report that they used specific instructional practices and testing accommodations. The number of methods courses taken by teachers and knowledge of course topics both contributed to the number of instructional practices and accommodations used by teachers.*

Educational reforms in the United States continue to place increasingly higher demands on youth with and without disabilities. These demands are measured through mandatory district and state assessments that directly affect whether or not students graduate (Gagnon & McLaughlin, 2004). For example, the No Child Left Behind Act (NCLB, 2001) includes a focus on high standards and accountability for student learning. The Individuals With Disabilities Education Act (1997) assures that students with special needs are also included in current educational reform via mandated access to the general education curriculum to the greatest extent possible and participation in assessments with accommodations, as needed. Subsequently, general and special educators are

faced with the task of assisting youth with disabilities, including those with learning disabilities (LD) and emotional/behavioral disorders (E/BD), to achieve maximum benefit from the curriculum and progress toward academic goals.

Provisions within NCLB (2001) and IDEA (1997) also increase the expectations of teachers. To assist students with special needs, teachers must have the knowledge and training to provide effective instructional practices and assessment accommodations. For example, in the area of mathematics, teachers are expected to provide effective instruction on curriculum that addresses higher level math skills and encompasses open-ended, problem-solving tasks (see Maccini & Gagnon, 2000) as set forth by the National Council of Teachers of Mathematics Standards (NCTM, 2000). Currently, 42 states (Blank & Dalkilic, 1992, as noted in Thurlow, 2000) have developed state math standards consistent with NCTM.

The use of effective instructional procedures and testing accommodations are critical because most youth with LD and E/BD experience difficulty acquiring and retaining math skills, such as algebraic reasoning skills (Maccini, McNaughton, & Ruhl, 1999) and basic skills/computational skills (Algozzine, O'Shea, Crews, & Stoddard, 1987). These students also have difficulty passing math tests aligned with state standards (Thurlow, Albus, Spicuzza, & Thompson, 1998). For example, Thurlow and colleagues determined that 83% of nondisabled eighth-grade students passed a Basics Standards Math Test, in comparison to 42% of students with E/BD and 34% of students with LD.

Given the difficulties that most students with LD and E/BD experience with mathematics, it is important to identify the instructional practices and assessment accommodations that help these students succeed in math. In this article, *instructional practices* refer to both empirically validated and recommended practices for teaching math to students with LD and/or E/BD. Empirically validated and recommended instructional practices and assessment accommodations are defined and discussed relative to the literature and the purpose of the current study.

INSTRUCTIONAL PRACTICES

As mandated by IDEA (1997), students with disabilities should have access to the general education curriculum and are entitled to empirically validated instructional practices that help them succeed. Empirically validated practices refer to research-based approaches to teaching math skills (Wilson, Majsterek, & Jones, 2001). Maccini and Gagnon (2000) determined that special and general education teachers of secondary students with LD and E/BD noted using a number of empirically validated approaches for teaching math to these students. These approaches included the following: (a) use of objects for conceptual understanding; (b) peer or cross-age tutoring strategies; and (c) organizational strategies for retention (e.g., cue cards of strategy steps, graphic organizers, mnemonics, and time for additional practice).

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Maccini and Gagnon (2000) also found that teachers noted using other instructional practices with students with LD and E/BD in math: (a) use of calculators; (b) assignment modifications (i.e., adjusted workloads); and (c) increased time for activities and tests. Assignment modifications included reducing classwork problems and homework problems and adjusting the workload via color coding or circles for cuing. Although these practices have yet to be validated with students with LD and E/BD, they were frequently noted, perhaps because they are recommended in special and general education textbooks. For example, in an introductory text for teaching math to students with special needs, experts (Bley & Thornton, 2001) recommend using visual cues and reduced classwork and homework problems. These recommended practices presumably help

math teachers plan and implement instruction that is beneficial for all students and help teachers from "spending an inordinate amount of time with one child to the exclusion of others" (Bley & Thornton, p. 22). Though cited by teachers in a statewide investigation (Maccini & Gagnon, 2002), no national studies exist that focus on teachers' use of empirically validated and recommended instructional practices to assist secondary students with LD and E/BD in math.

ASSESSMENT ACCOMMODATIONS

The National Council of Teachers of Mathematics (NCLB, 2001) mandates increased participation and accountability for all students, including students with disabilities, on high-stakes assessments that are tied to rigorous math standards. Assessment accommodations are necessary for some measures to help "level the playing field" for students with special needs (Thompson, Blount, & Thurlow, 2002). Experts define *accommodations* as modifying assessment procedures (e.g., scheduling, timing, presentation) or materials (e.g., setting, response) "that enable students with disabilities to participate in an assessment in a way that allows abilities to be assessed rather than disabilities" (Thurlow, Elliott, & Ysseldyke, 1998, pp. 28-29). In a statewide survey, Maccini and Gagnon (2000) determined that special and general education teachers of secondary students with LD and E/BD reported using a number of accommodations, including (a) presentation (e.g., color coding); (b) response (e.g., using reference materials such as cue cards or charts of strategy steps); (c) setting (e.g., behavioral modifications such as seating accommodation); (d) timing/scheduling (e.g., extended time on tests); and (f) calculators. However, only timing accommodations (Helwig, Rozek-Tedesco, Tindal, Heath, & Almond, 1999) and oral presentation (Calhoon, Fuchs, & Hamlett, 2000) have been empirically validated in math. The remaining accommodations reported included those that are commonly allowed on local and large-scale assessments (Menikoff, 2004). To date, no national studies exist that focus on teachers' use of empirically-validated and recommended assessment accommodations to assist secondary students with LD and/or E/BD in math.

Also lacking in the research on mathematics instruction is the identification of factors that may predict the number of instructional practices and assessment accommodations made for students with LD and E/BD. No information is available concerning (a) the contribution of teacher characteristics (e.g., number of years teaching); (b) special and general education math courses taken to teach math to students with LD and E/BD); (c) knowledge (e.g., familiarity with subject matter); (d) teacher type (e.g., general vs. special education teacher); and (e) classroom variables (e.g., number of students per class that need math assistance) in predicting the number of research-based instructional adaptations and assessment accommodations made by teachers. However, in a related study, Graham, Harris, Fink, and MacArthur (2003) found that, in addition to the amount of time spent writing, both teacher variables (e.g., number of years teaching) and classroom variables (e.g., number of students needing special education services) predicted the number of instructional practices teachers used with students who experienced difficulty with writing. Teacher type may also predict the number of instructional practices or assessment accommodations made for students with LD and/or E/BD. Researchers (Schumm et al., 1995) found that general education teachers allow fewer assessment accommodations. Also, as the number of methods courses taken by teachers positively affects student learning in secondary math courses (Monk, 1994), it is possible that the number of methods courses taken by teachers also influences the number of instructional practices and assessment accommodations.

To date, no national studies exist that focus on teachers' use of empirically validated and recommended assessment accommodations to assist secondary students with LD and/or E/BD in math.

TABLE 1

Participant Characteristics

Characteristics	No. (%)		Significance		
	Special Education Teachers	*General Education Teachers*	df	χ^2	p
Gender					
Female	69 (39)	53 (30)	1	.124	.725
Male	29 (17)	25 (14)			
Age					
20–29	7 (4)	6 (3)	3	2.570	.463
30–39	18 (10)	19 (11)			
40–49	42 (24)	24 (14)			
50–or >	32 (18)	28 (16)			
Educational Level					
Undergraduate	36 (21)	31 (18)	1	.317	.574
Graduate	61 (35)	44 (26)			

PURPOSE

Provisions within NCLB (2001) and IDEA (1997) require that students with special needs be exposed to the same curriculum as their nondisabled peers, to the greatest extent possible. Also, as mandated by IDEA, all students are required to participate in state assessments (with the exception of those that participate in alternate assessments) that are linked to the general education curriculum. The challenge, then, is to help educators provide effective instructional practices and appropriate assessment accommodations to help all students achieve within the general education mathematics curriculum and meet high standards. Using a nationwide sample, the current study was designed to answer three research questions. First, what specific instructional practices do special and general education teachers reportedly use for students with LD and E/BD *during instruction* on basic math computation skills and problem-solving tasks? Second, what specific accommodations do special and general education teachers reportedly make for students with LD and E/BD *when assessing* basic math skills and when assessing problem-solving tasks? Third, what factors predict the number of instructional practices and assessment accommodations general and special education teachers reportedly make for students with LD and E/BD?

METHOD

Surveys

A survey of secondary general and special educators teaching math to students with LD and E/BD was developed across three central topics: (a) teacher background information, (b) teacher perceived knowledge of secondary math topics, and (c) specific instructional practices and accommodations teachers use for students with LD and E/BD during instruction and when assessing basic math/computation skills and problem-solving tasks (see Tables 1, 2, and 3). For teacher background information, respondents were asked to provide information on their age, gender, educational level, years teaching students with LD and/or E/BD, teaching credentials, math methods courses taken, and type of math courses currently taught (e.g., prealgebra, algebra, algebra II, algebra II/trigonometry, geometry, statistics/probability, general mathematics or basic skills mathematics, integrated/unified high school mathematics, other). In addition, teachers completed a 4-point Likert-type scale to indicate their level of preparation for teaching math to students with LD and/or E/BD after completing their methods courses (ranging from *very prepared* to *very unprepared* = 4).

The second portion of the survey focused on teacher perceived knowledge of secondary

TABLE 2

Participants' Credentials and Current Teaching Responsibilities

Characteristics	No. (%)				Significance			
	Special Education Teachers		General Education Teachers		df	χ^2	p	ES
	Yes	No	Yes	No				
Secondary math teaching credential	7 (4)	94 (52)	76 (43)	2 (1)	1	144.966	.000	.90
Elementary math teaching credential	18 (10)	83 (46)	9 (5)	69 (39)	1	1.357	.244	–.09
Special education teaching credential	97 (54)	4 (2)	5 (3)	73 (41)	1	144.238	.000	–.90
Teaches Prealgebra	62 (34)	39 (22)	21 (12)	57 (32)	1	21.020	.000	–.34
Teaches Algebra	46 (26)	55 (31)	45 (25)	33 (18)	1	2.599	.107	.12
Teaches Geometry	27 (15)	74 (41)	25 (14)	53 (30)	1	.604	.437	.06
Teaches General Mathematics or Basic Skills (HS)	65 (36)	36 (20)	13 (8)	65 (36)	1	40.710	.000	–.48
Teaches Algebra II	6 (3)	95 (53)	13 (8)	65 (36)	1	5.377	.021	.17
Teaches Algebra II/ Trigonometry	1 (0)	100 (56)	4 (2)	74 (42)	1	—	.169[a]	.13
Teaches Statistics/ Probability	3 (2)	98 (55)	6 (3)	72 (40)	1	—	.181[a]	.11
Teaches Integrated/Unified High School Math	6 (3)	95 (53)	7 (4)	71 (40)	1	.601	.438	.06

Note. ES = coefficient phi; — = Insufficient cell size to calculate χ^2; [a] = Fisher's exact test value.

math topics. Teachers completed a 4-point Likert-type scale (ranging from *great deal* = 1 to *very little or nothing* = 4) to indicate their level of perceived knowledge to teach the eight math topics. For the final section of the survey, teachers indicated if they used specific instructional practices to help students with LD and/or E/BD with basic skills/computation and problem-solving tasks from a list of 14 choices (see Tables 4 and 5). Teachers also indicated if they used specific assessment accommodations to help students with LD and/or E/BD with basic skills/computation and for problem solving tasks from a list of eight choices (see Tables 4 and 5).

One version of the survey was constructed for general educators and another for special education teachers to address their unique teaching situations. The survey questions were identical, with the exception of three questions that applied solely to special education teachers (number of years as a special education teacher, number of students on caseload, current teaching position) and one question for general education teachers (number of years as a math teacher). Finally, it should be noted that coding for data entry was conducted for 25% of the responses. Data was entered accurately as the obtained reliability was 95%.

SAMPLE

Survey Sampling Procedures. The target population for the current study consisted of two groups of secondary teachers: (a) general education math teachers who teach students with LD and/or E/BD, and (b) special education teachers who teach math to students with LD and/or E/BD and/or collaborate with the general education math teachers. First, a random sample of 750 special and general educators from all public high schools in the United States was obtained from

TABLE 3

Years Teaching and Number and Nature of Methods Courses

	Mean Rating of Methods Courses on a 4-Point Scale[a]		*Significance*			
Survey Questions	*Special Education Teachers*	*General Education Teachers*	df	t	p	ES
How many years have you taught students with LD and/or E/BD?	12.36	1.15	176	–12.433	.000	.68
How many general education math methods courses have you taken?	1.61	3.16	91	3.719	.000	.36
How many special education math methods courses have you taken that addressed teaching math to students with LD and E/BD?	1.27	.56	163	–4.309	.000	.32
How prepared were you to teach math to students with LD and/or E/BD after completing your math education methods courses?	2.28[a]	2.75[a]	123	2.852	.005	.25
How prepared were you to teach math to general education students after completing your math education methods courses?	2.34[a]	1.74[a]	111	–4.171	.000	.37
How prepared were you to teach math to students with LD and/or E/BD after completing your special education courses that focused on teaching math?	1.94[a]	2.07[a]	88	–.868	.388	.09

Note. LD = learning disabilities; E/BD = emotional/behavioral disorders; ES = Cohen's *d*.

[a]4-point scale ranging from 1 = very prepared to 4 = very unprepared.

Quality Education Data (QED School Personnel Data Base, 2000/2001). Approximately 40% (n = 325) of the teachers sampled were general educators listed as having a special education class and currently teaching (a) algebra, (b) business/consumer math, (c) general/applied math, (d) geometry, (e) prealgebra, or (f) remedial math. Approximately 60% of the total sample (n = 425) were special educators. These teachers were listed as currently teaching students who were emotionally challenged, learning challenged, or had special needs and a special needs resource. The percentage of special educators sampled was greater than general educators, as the list of special educators was not limited to those teachers who teach only mathematics. Thus, more special educators needed to be sampled to account for ineligibility (e.g., special education teachers who teach students with learning challenges but do not teach math). Surveys were then mailed to the targeted teachers.

Response Rate. Of the 750 surveys mailed, 257 surveys were excluded from the analysis because of concerns about (a) ineligibility (teachers either returned surveys with a note or made contact by phone saying they do not teach relevant courses; n = 250), or (b) incorrect school address (n = 7). Thus, a total of 493 (278 special education; 215 general education) teacher surveys met the criteria for inclusion. Of these, 101 special education teachers returned the survey for a response rate of 36%, and 78 general education teachers returned the surveys for a return rate of 36%. The response rate remained below a common survey

return rate of 50% (Weisberg, Krosnick, & Bowen, 1989). This occurred even though there were two mailings, a follow-up postcard sent between the mailings, and a phone call to all eligible participants after the second mailing.

Demographics

Of the 176 teachers that responded to the question (3 were missing), 44% (n = 78) were general education teachers and 56% (n = 98) were special education teachers who teach math to students with LD and/or E/BD (see Tables 1 and 2). Further, 69% (n = 122) of the total respondents were female, most of whom were special education teachers (n = 69, 57%). The majority of respondents noted being 40 years of age or older (n = 126, 72%) and holding graduate degrees (n = 105, 61%). No significant differences were determined among general and special educators with regard to gender, age, or educational level.

To determine if there were statistical differences between general and special education teachers on the variables included in Tables 2 and 3, chi square and t-tests were conducted. If statistically significant differences were found, the magnitude of the effect, or effect size (ES), was computed (Cohen's d for the t-test; coefficient phi for chi square analysis). Cohen's d values range from .2 (small), .5 (medium), to .8 (large). For coefficient phi, the range is 0 (proportions of the sample are equal to the hypothesized proportions) to 1 (proportions of the sample are as divergent as possible to the hypothesized proportions).

As can be seen from Tables 2 and 3, there were a number of differences between general and special education teachers. Special education teachers were almost 11 times more likely to teach students with LD and/or E/BD, than general education teachers. In addition, special education teachers were almost 20 times more likely to have special education credentials than general education participants, but more than 10 times less likely to hold secondary math credentials. As expected, no significant difference was determined among general and special educators with regard to holding an elementary math credential.

Statistical significance (t = -7.001, df = 89, p = .000; ES = .60) was determined across teacher type and the average number of students with LD and/or E/BD who are provided assistance (e.g., in class support, resource room), with special education teachers noting a greater average of students who are provided assistance (M = 13.73, SD = 10.89) than general education teachers (M = 3.08, SD = 3.51). Concerning current teaching position, 60% (n = 61) of special educators taught full time in either a resource room or segregated classroom setting. Only 12% of special educators (n = 12) reported being a full-time consultant or team teaching on a full-time basis.

Teachers also reported the type of math courses they currently teach to students with LD and/or E/BD. Special education teachers were five times more likely to teach general math or basic skills classes and three times more likely to teach prealgebra classes to students with LD and/or E/BD than were general education participants. There was insufficient cell size to calculate chi-square statistics for the number of teachers teaching algebra II/trigonometry classes and statistics/probability classes. However, general education teachers were twice as likely to teach algebra II to students with LD and/or E/BD than were special education teachers. No statistically significant differences were found across teacher type for algebra, geometry, and integrated/unified mathematics.

Teachers were asked to indicate the number of general and special education methods courses taken that addressed teaching math to students with LD and E/BD and their level of preparation for teaching math to these students. General education teachers were almost twice as likely to take general education methods courses than were special education participants. Special education teachers were more than twice as likely to take special education methods courses than were general education participants.

For teachers who noted taking at least one special or general education methods course (n = 187), respondents also reported their level of preparation for teaching math to students with LD and/or E/BD as a result of the methods courses they had completed. For general education methods courses completed, special education teachers indicated feeling more prepared to teach math to students with LD and/or E/BD (M = 2.28, SD = .95) than were general education teachers (M = 2.75, SD = .92); whereas general

education teachers felt more prepared to teach math to general education students (M = 1.74, SD = .69) than were special education teachers (M = 2.34, SD = .93). There were no statistically significant differences in teachers' perceptions to teach math to students with LD and E/BD as a result of taking special education methods courses (M =2.07, SD = .72 for general educators; M = 1.94, SD = .67 for special educators).

RESULTS

Research Question 1: Instructional Practices

Teachers were queried on their use of 14 instructional practices with students with LD and/or E/BD during instruction of basic math skills/computational tasks (see Table 4) and multistep problem-solving tasks (see Table 5). Overall, the mean number of instructional practices on basic math skills/computational tasks they reported using was 9.13 (SD = 2.86) for special educators and 6.17 (SD = 2.89) for general education teachers. The mean number of instructional practices they reported using on multistep problem-solving tasks was 8.46 (SD = 3.08) for special educators and 9.09 (SD = 2.57) for general education teachers. A statistically significant difference existed between the groups on the average number of instructional practices used with basic math facts (t = -6.860, df = 177, p = .000; ES = .46), with special educators reporting using more instructional practices than general educators. No statistically significant differences were noted between special and general educators for the overall use of these procedures with problem-solving tasks.

Basic Skills/Computational Tasks. As can be seen in Table 4, special educators were more likely to report that they used the following instructional procedures with students with LD and/or E/BD when teaching basic skills/computational tasks: individualized instruction by teacher, additional practice, reduced classwork problems, extended time on assignments, problems read to students, cue cards of strategy steps, individualized attention given to student by classroom aide, and graphic organizers. Across special education teachers, the four most reported applied instructional practices during basic skills/computational tasks included: calculators, individualized instruction by teacher, extended time on assignments, and problems read to students. General education teachers reported using the following most frequent instructional practices: calculators, extended time on assignment, individualized instruction by teacher, and peer or cross-age tutoring.

Problem-Solving Tasks. As shown in Table 5, special educators were more likely to report that they used the following instructional procedures with students with LD and/or E/BD when teaching multistep problem-solving tasks: individualized instruction by teacher, additional practice, reduced classwork problems, extended time on assignments, reduced homework problems, problems read to students, cue cards of strategy steps, use of concrete objects, and graphic organizers. Across special education teachers, the four most reported applied instructional practices during multistep problem-solving tasks included: problems read to students, individualized instruction by teacher, extended time on assignments, and calculators. General education teachers reported most frequent use of the following instructional practices: calculators, individualized instruction by teacher, extended time on assignment, and peer or cross-age tutoring.

Research Question 2: Assessment Accommodations

Teachers were queried on their use of eight assessment accommodations with students with LD and/or E/BD while assessing student knowledge of basic math skills/computational tasks (see Table 4) and multistep problem-solving tasks (see Table 5). Overall, the mean number of assessment accommodations on basic math skills/computational tasks they reported using was 4.52 (SD = 1.75) for special educators and 3.14 (SD = 1.36) for general education teachers. The mean number of assessment accommodations they reported using on multistep problem-solving tasks was 4.54 (SD = 2.05) for special educators and 3.18 (SD = 1.40) for general education teachers. Statistically significant differences existed between the groups for the average number of assessment accommodations used with basic math facts

TABLE 4

Instructional Practices and Assessment Accommodations Used During Instruction on Basic Math Skills/Computational Tasks

	No. (%)				Significance			
	Special Education Teachers		General Education Teachers					
Characteristics	Yes	No	Yes	No	df	χ^2	p	ES
Type of Instructional Practices								
Individualized instruction by teacher	93 (52)	8 (4)	57 (32)	21 (12)	1	11.706	.001	.26
Additional practice	83 (47)	18 (10)	31 (17)	47 (26)	1	34.268	.000	.44
Reduced classwork problems	74 (41)	27 (15)	33 (19)	45 (25)	1	17.545	.000	.31
Extended time on assignments	93 (52)	8 (4)	61 (34)	17 (10)	1	7.050	.008	.20
Reduced homework problems	58 (33)	43 (24)	31 (17)	47 (26)	1	5.504	.019	.18
Color coding	23 (13)	78 (44)	9 (5)	69 (38)	1	3.783	.052	.15
Peer or cross-age tutoring	64 (36)	37 (20)	48 (27)	30 (17)	1	.063	.802	.02
Problems read to students	93 (52)	8 (5)	40 (22)	38 (21)	1	38.364	.000	.46
Cue cards of strategy steps	44 (25)	57 (32)	8 (4)	70 (39)	1	23.690	.000	.36
Use of concrete objects	66 (37)	35 (20)	38 (21)	40 (22)	1	4.999	.025	.17
Individualized attention by class aide	55 (30)	46 (26)	21 (12)	57 (32)	1	13.655	.000	.28
Calculators	98 (54)	3 (2)	71 (40)	7 (4)	1	—	.106[a]	.13
Graphic organizers	36 (20)	65 (36)	13 (8)	65 (36)	1	7.972	.005	.21
Mnemonics	42 (24)	59 (33)	20 (11)	58 (32)	1	4.941	.026	.17
Type of Assessment Accommodations								
Reduced problems on tests	60 (34)	41 (23)	18 (10)	60 (33)	1	23.624	.000	.36
Extended time on tests	94 (53)	7 (4)	67 (37)	11 (6)	1	2.503	.114	−.12
Calculators	93 (52)	8 (4)	69 (39)	9 (5)	1	.670	.413	.06
Cue cards of strategy steps	28 (15)	73 (41)	7 (4)	71 (40)	1	9.835	.002	.23
Color coding	13 (7)	88 (50)	4 (2)	74 (41)	1	3.070	.080	.13
Use of concrete objects	39 (22)	62 (35)	20 (11)	58 (32)	1	3.352	.067	.14
Problems read to students	86 (48)	15 (8)	37 (21)	41 (23)	1	29.117	.000	.40
Individualized attention given by class aide	44 (24)	57 (32)	23 (13)	55 (31)	1	3.724	.054	.14

Note. ES = coefficient phi; — = Insufficient cell size to calculate χ^2; [a] = Fisher's exact test value.

TABLE 5

Instructional Practices Used During Instruction on Multistep Problem-Solving Tasks

	No. (%)				Significance			
	Special Education Teachers		General Education Teachers					
Characteristics	*Yes*	*No*	*Yes*	*No*	df	χ^2	p	ES
Type of Instructional Practices								
Individualized instruction by teacher	90 (51)	11 (6)	56 (31)	22 (12)	1	8.774	.003	.22
Additional practice	77 (43)	24 (13)	34 (19)	44 (25)	1	19.913	.000	.33
Reduced classwork problems	62 (35)	39 (22)	29 (16)	49 (27)	1	10.318	.001	.24
Extended time on assignments	87 (49)	14 (8)	53 (29)	25 (14)	1	8.545	.003	.22
Reduced homework problems	58 (33)	43 (24)	22 (12)	56 (31)	1	15.203	.000	.29
Color coding	17 (10)	84 (47)	5 (3)	73 (41)	1	4.434	.035	.16
Peer or cross-age tutoring	57 (32)	44 (25)	46 (25)	32 (18)	1	.116	.733	–.03
Problems read to students	91 (51)	10 (6)	45 (25)	33 (18)	1	25.324	.000	.38
Cue cards of strategy steps	48 (27)	53 (30)	13 (7)	65 (36)	1	18.655	.000	.32
Use of concrete objects	63 (35)	38 (21)	28 (15)	50 (28)	1	12.346	.000	.26
Individualized attention by class aide	50 (28)	51 (29)	25 (14)	53 (29)	1	5.507	.019	.18
Calculators	87 (49)	14 (8)	66 (36)	12 (7)	1	.082	.774	.02
Graphic organizers	34 (19)	67 (37)	9 (5)	69 (38)	1	11.804	.001	–.26
Mnemonics	33 (18)	68 (38)	16 (9)	62 (35)	1	3.274	.070	–.14
Type of Assessment Accommodations								
Reduced problems on tests	66 (37)	35 (20)	22 (12)	56 (31)	1	24.292	.000	.37
Extended time on tests	90 (50)	11 (6)	63 (35)	15 (9)	1	2.465	.116	.12
Calculators	89 (50)	12 (7)	67 (37)	11 (6)	1	.194	.660	.03
Cue cards of strategy steps	30 (17)	71 (40)	8 (4)	70 (39)	1	9.953	.002	.24
Color coding	13 (8)	88 (49)	6 (3)	72 (40)	1	1.244	.265	.08
Use of concrete objects	49 (28)	52 (29)	17 (9)	61 (34)	1	13.500	.000	.28
Problems read to students	82 (46)	19 (11)	41 (23)	37 (20)	1	16.774	.000	.31
Individualized attention by class aide	40 (22)	61 (34)	24 (14)	54 (30)	1	1.495	.221	.09

Note. ES = coefficient phi.

($t = -5.753$, $df = 177$, $p = .000$; ES = .40) and problem-solving tasks ($t = -5.044$, $df = 177$, $p = .000$; ES = .35), with special educators reporting using more assessment accommodations than general educators.

Basic Skills/Computational Tasks. As can be seen in Table 4, special educators reported that they more likely used the following accommodations with students with LD and/or E/BD when assessing knowledge on basic skills/computational tasks: reduced problems on tests, cue cards of strategy steps, and problems read to students. Across special education teachers, the four most reportedly applied accommodations provided when assessing knowledge of basic math skills/computational tasks included: extended time on tests, calculators, problems read to students, and reduced problems on tests. General education teachers reported using the following accommodations most frequently: calculators, extended time on assignment, problems read to students, and individualized attention given to student by classroom aide.

Problem-Solving Tasks. As shown in Table 5, special educators reported that they were more likely to use the following accommodations with LD and/or E/BD when assessing knowledge of multistep problem-solving tasks: reduced problems on tests, cue cards of strategy steps, use of concrete objects, and problems read to students. Across special education teachers, the four most reported applied accommodations when assessing knowledge of multistep problem-solving tasks included: extended time on tests, calculators, problems read to students, and reduced problems on tests. General education teachers reported using most frequently the following accommodations: calculators, extended time on tests, problems read to students, and individualized attention given to student by classroom aide.

Research Question 3: Factors Affecting Teacher Response

Four nonhierarchical regression analyses were conducted to examine the contribution of three predictor variables on the number of instructional practices and assessment accommodations reported by general and special education teachers. This was done separately for general and special education teachers for the following two indices: total number of reported instructional practices and total number of reported accommodations. First, each predictor variable was entered into the first position of the linear equation to determine if it was significantly related to the outcome variable (e.g., total number of reported instructional practices). In addition, each variable was entered into the last position to determine if it contributed to the prediction of the outcome variable (e.g., total number of reported accommodations) beyond the contribution of the other two variables. The predictor variables were (a) years teaching students with LD and/or E/BD; (b) number of methods courses completed; and (c) knowledge of math topics (i.e., prealgebra, algebra, geometry, general or basic skills math, algebra II, and algebra II/trigonometry). Data for knowledge of math topics is included in Table 6. It is interesting to note that general education teachers were more familiar than were special education teachers with the topics of prealgebra, algebra, geometry, algebra II, algebra II/trigonometry, statistics/probability, and integrated/unified high school math.

Instructional Practices

Special Education Teachers. The three predictor variables accounted for 11.7% of the variance in the total number of instructional practices special education teachers noted using with students with LD and/or E/BD on basic math/computational skills and problem-solving tasks (see Table 7). The t-test for Beta weights was statistically significant for two predictor variables (knowledge of math topics and number of methods courses) when entered into the first position of the regression model. When entered into the last position, one variable (knowledge of math topics) contributed significantly to the prediction of instructional practices above and beyond the other predictor variables. Knowledge of math topics accounted for 6.1% of the total variance after the other variables were controlled.

General Education Teachers. The three predictor variables accounted for 12.5% of the variance in the total number of instructional practices general teachers reported using with students with LD and/or E/BD on basic math/computational skills and problem-solving tasks (see Table 7). The t-test for Beta weights was statistically significant for the first predictor variable (number of meth-

TABLE 6

Teacher Perceived Knowledge of Secondary Math Topics

Teacher Perceptions	Special Education Teachers	General Education Teachers	Significance df	t	p	ES
How much do you feel you know about each of the math topics listed below?						
Prealgebra	1.53 (.70)	1.06 (.30)	134	–5.497	.000	.43
Algebra	2.07 (.84)	1.12 (.40)	143	–9.153	.000	.61
Geometry	2.54 (.86)	1.49 (.70)	169	–8.590	.000	.55
General Mathematics or Basic Skills (HS)	1.14 (.38)	1.08 (.32)	167	–1.117	.265	.09
Algebra II	2.92 (.82)	1.35 (.60)	166	–13.958	.000	.74
Algebra II/Trigonometry	3.37 (.80)	1.62 (.76)	164	–14.464	.000	.75
Statistics/Probability	3.07 (.80)	2.01 (.84)	157	–8.275	.000	.55
Integrated/Unified High School Math	2.98 (1.03)	2.14 (1.06)	152	–5.095	.000	.38

Note. ES = Cohen's *d*. Ratings based on a 4-point scale with 1 = a great deal; 2 = quite a lot; 3 = some; 4 = very little or nothing.

ods courses) when it was entered into the first and last position of the regression model. For general education teachers, the number of methods courses taken accounted for 9.6% of the variance after the other variables were controlled.

Assessment Accommodations

Special Education Teachers. The three predictor variables (years teaching students with LD and/or E/BD, knowledge of math topics, and number of methods courses) accounted for 4.7% of the variance in the number of assessment accommodations used by special educators (see Table 8). The *t*-tests for Beta weights were not statistically significant for any of the predictor variables when they were entered into the first position or the last position of the regression model.

General Education Teachers. The three predictor variables accounted for 12.5% of the variance in the number of assessment accommodations made by general educators (see Table 8). The *t*-test for Beta weights was statistically significant for one predictor variable (total number of methods courses) when entered into both the first and last position. For general education teachers, the number of methods courses taken accounted for 11.1% of the total variance above and beyond the other variables.

DISCUSSION

This study provides a national picture of secondary general and special educator views concerning their reported level of preparation to teach math and their perceived knowledge of math. We also examined teacher use of specific instructional practices and assessment accommodations. In addition, we examined the contribution of experience, knowledge, and preparation in predicting teachers' reported use of instructional practices and testing accommodations.

We found that special education teachers indicated they were less familiar with secondary math knowledge than were general educators (the only exception involved general mathematics or basic skills). Furthermore, both general and special education teachers take few methods courses that focus on teaching math to students with LD and/or E/BD. Only one of every two general

TABLE 7

Nonhierarchical Regression Analysis for General Education and Special Education Teachers' Instructional Approaches

	Initial Entry of the Construct			*Construct Entered in Last Position*	
Variables	*Simple* R	R^2	p-*value*	R^2 *Increment*	p-*value*
General Education Teachers					
Mean perceived knowledge	.090	.008	.444	.009	.488
Total number of methods courses	.368	.136	.006	.096	.025
Total years teaching LD and/or E/BD	.124	.015	.279	.007	.533
Special Education Teachers					
Mean perceived knowledge	.234	.055	.031	.063	.030
Total number of methods courses	.247	.061	.023	.031	.124
Total years teaching LD and/or E/BD	.055	.003	.587	.026	.157

education teachers took such a course, whereas special educators averaged only 1.27 courses of this nature. It is possible that the relatively small numbers of methods courses taken by these teachers influenced their general perceptions that they were not adequately prepared to teach math to these students. These findings are consistent with previous research (Maccini & Gagnon, 2002).

Specific Instructional Practices and Factors

In the present study, it was determined that (a) special educators used significantly more recommended instructional practices than did general educators for computational and problem-solving tasks; (b) special education teachers' familiarity with course topics significantly and uniquely contributed to the prediction of the number of instructional practices they provided to secondary students with LD and/or E/BD in math; and (c) the number of methods courses taken by general education teachers contributed to the prediction of the number of instructional practices they made for students with LD and/or E/BD in math.

A statistically significant difference existed between special educators and general educators on the average number of instructional practices used with basic math facts, with special educators

TABLE 8

Nonhierarchical Regression Analysis for General Education and Special Education Teachers' Assessment Accommodations

	Initial Entry of the Construct			*Construct Entered in Last Position*	
Variables	*Simple* R	R^2	p-*value*	R^2 *Increment*	p-*value*
General Education Teachers					
Mean perceived knowledge	.047	.002	.688	.002	.744
Total number of methods courses	.368	.135	.006	.111	.016
Total years teaching LD and/or E/BD	.063	.004	.583	.009	.493
Special Education Teachers					
Mean perceived knowledge	.080	.006	.465	.012	.345
Total number of methods courses	.207	.043	.057	.028	.161
Total years teaching LD and/or E/BD	.043	.002	.670	.007	.473

reporting using more instructional practices than general educators. In fact, for each instructional procedure, all but three instructional practices (i.e., color coding, peer or cross-age tutoring, and calculators) were statistically significantly different, favoring special educators. No statistically significant differences were noted between special and general educators for the overall use of the 14 instructional procedures with problem-solving tasks. However, for each instructional procedure, special educators favored all but three (peer or cross-age tutoring, calculators, and mnemonics).

. . . both general and special education teachers take few methods courses that focus on teaching math to students with LD and/or E/BD.

Certain contextual information may help to explain teacher differences. First, these two groups of teachers differ greatly in terms of years of experience teaching students with LD and/or E/BD (M = 12.36 years for special educators; M = 1.15 years for general educators). Also, general education math teachers may have only a few students with disabilities in their classes; whereas special educators may be working almost entirely with students with special needs.

Despite differences between general and special educators in the number of recommended instructional practices, there were several similarities among the most frequent instructional practices reported. Specifically, during basic skills/computational tasks, special and general education teachers both reported using the recommended practices of individualized instruction by teacher, extended time on assignments, and use of calculators. The use of calculators was also a common response across teacher-type during problem-solving tasks. These results are encouraging given the support from the literature for the critical need of providing enough time for students with LD to learn information, establishing high success rates, and developing strategies for helping students to learn and retain information (Mercer, 1997). Although no studies currently exist that examine the efficacy of standard and/or graphing calculators on the math performance of secondary students with LD, calculators hold great promise for students with special needs. Maccini and Gagnon (2005) noted the positive results of calculator use with nondisabled students relative to motivational factors, concept development, and student achievement.

Although the fourth most frequent response across teacher types differed, the variation may be a function of resource availability. For instance, special education teachers reported using "problem read to students" as their fourth most frequent instructional procedure, whereas general education teachers noted the use of "peer or cross-age tutoring" for helping students with special needs on problem-solving and basic skills/computational tasks. This is not surprising given the heterogeneous nature of general classrooms with varied skill levels and the need to cover the curriculum. Use of peer tutoring has proven beneficial during independent practice for secondary students studying introductory algebra skills (Allsopp, 1997).

Specific Assessment Accommodations and Factors

We found that special educators used more assessment accommodations than did general educators for both computational and problem-solving tasks, and the total number of methods courses taken predicted teacher use of assessment accommodations. More specifically, we found that special educators were more likely than general educators to reduce the number of problems on tests, use cue cards of strategy steps, and problems read to students for both basic math skills and problem-solving. They were also more likely to use concrete objects as an accommodation for problem-solving.

We found that special educators used more assessment accommodations than did general educators for both computational and problem-solving tasks. . .

Despite differences among general and special educators in the number of assessment accommodations, there were several similarities among the three most frequent assessment accommodations reported by both groups. These included (a) extended time on tests, (b) calculators, and (c) problems read to students. These results are positive given the documented research. Specifically, Thompson et al. (2002) summarized and critically evaluated empirical research studies from 1999 to 2001 that examined the effects of specific assessment accommodations. The researchers categorized the types of accommodations across common formats (presentation, response, setting, timing/scheduling, multiple accommodations, other) and determined that the use of two formats (extended time and oral presentation) had generally positive results on students' test scores. For example, Calhoon et al. (2000) noted positive results on a math performance assessment for secondary students with LD with a teacher read aloud accommodation, rather than standard paper/pencil administration. Helwig et al. (1999) reported similar results for students experiencing math difficulties, regardless of their reading ability level. With extended time, Fuchs, Fuchs, Eaton, Hamlett, and Karns (2000) determined positive results for students with LD in math on a curriculum-based math measurement.

It should also be noted that there were some inconsistencies between teachers' use of specific procedures for instruction and for assessment. For example, the use of calculators was a frequent response for special education teachers as an assessment accommodation during problem-solving tasks, but was not among the most frequent responses as an instructional procedure. It is important that students have training and experience with available assessment accommodations during instruction (Thurlow, 2000).

LIMITATIONS AND FUTURE RESEARCH

Five important limitations existed within the current study. First, generalization of findings may be at risk because of the small sample size and the low response rate. The response rate remained low despite multiple mailings and repeated reminders. Also, comparisons between the respondents and nonrespondents were not available. This was due to the restrictions concerning participant confidentiality from the survey company that managed the mailings and returns. Future research needs to include a larger sample and comparisons across respondents and nonrespondents to increase the validity of findings. Also, it is not known whether the general educators sampled had some students with special needs in their class or if they taught a class completely comprised of students with special needs. Variations in students within a class may have an impact on instructional approaches and assessment strategies and should be studied further. Furthermore, it may be of concern that the same choices existed for questions concerning basic computational and problem-solving tasks. Future research should include a more comprehensive list of instructional practices.

In the current study the number of methods courses uniquely and significantly contributed to the prediction of the number of assessment accommodations used by general educators. However, two issues remain unanswered: (a) details concerning the methods courses taken (e.g., focus of the courses, when courses were taken, how course activities related to field experience); and (b) the extent to which the reported assessment accommodations were appropriate in type and number for students and whether they were aligned with state policies (Pitoniak & Royer, 2001). Future research should examine the effects of types of methods courses to the number of instructional practices and assessment accommodations used. Also, it is important to note that the total amount of variance accounted for in the regression analysis was relatively low. Future research needs to expand the list of possible predictors used to assess reported instructional practices and accommodations.

INSTRUCTIONAL IMPLICATIONS

This study raises several questions about who should teach math to secondary students with LD and/or E/BD. On the one hand, general education teachers appear to be more knowledgeable about secondary math. On the other hand, special education teachers have more formal course-

work on how to teach math to students with LD and/or E/BD, and they are more likely to use the recommended instructional practices and accommodations that were included in this study. Instead of worrying about who is best equipped to teach these students, it may be more productive to examine how general and special educators can work together to facilitate these students' progress in math (Thompson, Lazarus, & Thurlow, 2003). As Kozleski, Mainzer, and Deshler (2000) stated, "Special and general educators must work together to ensure that the highest possible number of students with exceptionalities successfully accesses the important concepts and skills in the general education curriculum" (p. 11).

The findings from this study indicate that special education teachers need more preparation in content of secondary mathematics, and general educators would benefit from additional preparation in instructional practices and accommodations for learners with special needs. It is unfortunate that some states do not have math requirements for special education preparation programs (Graham & Fennell, 2001), as teacher content knowledge and course completion have a positive effect on student achievement (Good & Grouws, 1987; Tooke, 1993).

One approach to increasing special educators' knowledge of secondary mathematics is to integrate such information into existing preservice methods courses. Methods courses that addressed both mathematics pedagogy and domain knowledge had a significant impact on preservice teachers' attitude toward math and significantly increased their domain-specific knowledge of math (Quinn, 1997). Jenkins, Pateman, and Black (2002) also agreed that dual certification programs can help secondary special education teachers obtain content-specific knowledge and general educators sharpen their instructional practices.

Another approach for enhancing special educators' knowledge and general educators' instructional practice is the use of ongoing, comprehensive staff development opportunities (Koency & Swanson, 2000; Whittington, 2002). Whittington reported that 55% of all mathematics teachers surveyed in the 2000 National Survey of Science and Mathematics Education indicated a need for more professional development opportunities that focus on teaching students with special needs. Obviously, such support can be offered in conjunction with university coursework (Time is Key, 2002 in Thompson et al., 2003).

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